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Scheduling Algorithm used in Live Media Streaming Based on Data-drive Overlay Network

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Abstract

To improve the playback quality of P2P media streaming system terminal nodes and enhances the overall performance, a data scheduling algorithm(LDSA) is proposed, it is able to dynamically adjust the pending request according to the node ability. The algorithm in satisfies the media streaming living in the time response foundation, had considered how to minimize the waiting time for the requests in the node and the rapid distribution in network of scarce data blocks. Through compares with the existing scheduling algorithm, the experimental results are proved that the MDSA algorithm have the prominent performance in diminishing the accumulated latency and enhancing the media broadcast quality

*Keywords:*P2P networking; media streaming; DOnet; data scheduling ; rarest first

1. Introduction

With the developing of the large storage, the high-performance workstations and the wide brand, the transmission of information is not merely confined to the text and images in the internet, so the technology of media streaming found wide application. However, the media streaming service of traditional C/S(Client/Server) patterns, because of the performance bottlenecks, it's scalability and fault tolerance cannot satisfy the requirements. Though the pattern of C/S consumes a large and expensive server bandwidth, but the client is still difficult to achieve a satisfactory media broadcast quality. The

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main reason is the C/S mode's completely dependent on the server's performance such as bandwidth and computing power, and this make it can not very well adapt to mass media streaming release.

P2p media streaming technology through the actively use of client's unused resources such as network, computing and storage to reduce the consumption of server's network bandwidth resources and local network congestion, and self organization make system has good extensibility and be more suitable for media streaming's properties such as high bandwidth demands, dynamic, and strong isomerism. At the same time, the media streaming system base on P2P does not need to erect special infrastructure and does not need the support of IP multicast , it turns to a new way to resolve media streaming content distribution, and aroused highly attention.

In the P2P multi-source media streaming system, a number of senders with different bandwidth send data to one receiving node, in order to ensure low service delay and service continuity and stability, the receiving node should schedule the data transmission of the sending nodes, decided each sender's sending rate and data segment. Aiming at the P2P media streaming system based on DONet(Data-drive Overlay Network)[1] ,a simple and effective data scheduling algorithm(LDSA) is proposed in the paper, the algorithm is combined with the least priority strategy (RF strategy), through the division of the node buffer to distinguish the data level, and the emergency data blocks in peer nodes are regulated to reduce the buffer time while estimating the node capacity , this improves the quality of streaming media.

2. Related Work

According its working way, the data distribution of existing P2P live media streaming system divided into three categories: data scheduling polices based on single cast tree, based on multicast tree and based on random topology.

Based on single cast tree, such as Spreadit[2] etc. The main problems of the schemes are an internal node in a tree has heavy load and the bandwidth resource of its leaves is not used effectively, and the node's leave or failure will seriously affect its child nodes of the transmission services; Based on multicast tree, such as SplitStream[3], the maintenance and management of the multicast tree is complex ,this leading to high cost, lack of scalability, and all its desired sub streaming must reach before decoding; Based on random topology ,such as DOnet, through Gossip Protocols to build an unstructured network coverage, to a large extent this structure makes up the defect of the tree models, data availability information is utilized to guide the flow of data, thereby effectively improving the stability of the system and the throughput of the system, and enable it to carry out large-scale live media streaming service on the Internet.

A data scheduling algorithm based on the Data-driven Overlay Network is proposed in the paper. The nodes in the Data-driven Overlay Network are random topological, and there are not strict relationship between father and son, internal and external , upstream and downstream; When a node joins ,it acquires randomly a number of nodes from system through some mechanisms and establishes the partnership. So it is simple, robust, efficient, its advantages mainly manifested in higher fault tolerance and bandwidth utilization rate, more suitable for large-scale, high dynamic network environment.

The data scheduling algorithm in Data-driven Overlay Network is a variation of the Parallel machine scheduling, which is known NP-hard. It is thus not easy to find an optimal solution. Rarest first was adopted in its data scheduling policy. Firstly, the Peer calculates the number of potential suppliers for each segment (i.e., the number of partners containing the desired data block in their buffers), then the Peer obtains the data segments which have only one provider, followed by obtaining the data segments which have two providers, followed by analogy. Among the multiple potential suppliers, the one with the highest bandwidth and enough available time is selected. The algorithm thus can be frequently executed to update the schedule. However, this algorithm which depends on the numbers and validity of the data copy, mainly considered to download the data from which neighbor, without considering immediate response to the urgent data blocks and the priority to improve overall system performance. In addition RF policy needs to notice in advance each partner node of the bandwidth, which in the real time network environment is difficult to measure.

3. Scheduling Algorithm

Firstly, we divide the media streaming data into a number of data blocks of the same length, and the node buffer is divided into a warning and a no-warning zone according to a certain proportion, such as 1: 5 (specific partition is relevant to the called interval of scheduling algorithm and the video Bit Rate), it is used the Buffer Map(BM) to record the data availability information in the node buffer. From the view of single block, they are all the first to warning zone and then enter no-warning, so in order to get better quality of playback, reducing the number of data blocks missed Deadline, the data in the warning zone is closer from playing which is emergency data should be priority requested, and the previous data is preferred.

Node ability is calculated by the bandwidth that the neighbor nodes can assigned to the node i. Let $W^{(m)}$ denote the bandwidth that a neighbor node k can assigned to node i in the m scheduling cycle, $Q^{(m)}$ denotes the total number of data block which k sends to i in the m scheduling cycle. We estimate the bandwidth $W^{(m+1)}$ which k assign to i in the m+1 cycle by the average number of data blocks from k to i in the 1 to M cycle. We thus have

$$W^{(m+1)} = \gamma \cdot \left(\sum_{l=m-M+1}^{m} Q^{(l)} / MT \right) \tag{1}$$

That is, T denotes scheduling cycle, γ denotes Occupation coefficient constant.

The asymmetry of the network communication bandwidth make the node upload bandwidth is significantly less than the download bandwidth. When a request reaches the neighbor node, then it must wait for the earlier requests are processed. If the neighbor node has idle bandwidth, it will get service. Assuming that each node has a queue Q for storing the requests from other Peers, the arriving request is serviced according to the node's upload bandwidth in the order of FIFO. And in order to meet the time characteristic of live media streaming system, data in warning zone should be higher priority to be requested, so that it can be played before deadline. Because the play is far away , the data in no-warning zone is in no hurry to get service. We adopt different scheduling methods in the different areas of the node buffer, therefore in order to distinguish the data between the warning and no-warning zone, each request message is added to a mark when a node sends requests. If the data is in the warning zone, the flag is 1 to indicate an urgent request, otherwise the flag is 2.

When an urgent request reaches the service queue Q in the partner S, if S has the requests are earlier than it, it can not immediately be serviced. In order to reduce the waiting time, the request attempts to remove the earlier Non urgent request to another node to obtain services, however urgent request will not be processed. The node first checks the cache information from other partner, to see whether there is node that can provide service for the urgent requests.

Scheduling algorithm pseudo code as follows:

request_data[]; a set of the requests
dup[*i*]; The copy amount of data block i
WA; The warning zone
NWA; The no-warning zone

```
bm[i];          The buffer image of i
band[i];          The bandwidth of partner i
num_partners;     The amount of partners
request_data=∮; // The request collection set null
for(i=1; i<num_partners; i++)
caculate capability of partner i –band[i]; // Calculate each partner capacity
 tmppiece_set={piece|piece∈WA && bm[piece]=0};
if(tmppiece_set != ∮ )
   put tmppiece_set into request_data; //  Palce missing segment of the warning  in request set
tmppiece_set=rand{piece1|dup[piece1]<dup[piece2], piece1, 2∈NWA,bm[piece1,2]=0}
if(tmppiece_set != ∮)
put tmppiece_set into request_data untill request_data is full; //  Place missing segment of  no-warning in request set
for(j=0;j<request_data.length;j++){  tmp_piece=request_data[j];tmp_partner_set=rand{partner1|band[partner1]>band[partner2],partner1,2.bm[tmp_piece]=1}
   tmp_partner=tmp_partner_set[0];// The most capability
   tmservice=request(tmp_partner,tmppiece,flag); // Whether request successful
   if(tmservice==0&&flag==1){
      while(there is some non-urgent request before this){
   tmp_partner_set=rand{partner1|lantency(partner1)<lantency(partner2),
partner1,2.bm[tmp_piece]=1};  // tmp_piece denotes a no-urgent request before the current request
   if(lantency (tmp_partner_set[0])<lantency(tmp_partner))
      move this non-urgent request to tmp_parnter;
```

4. Simulation And Performance Analysis

Linux Redhat 9 has been adopted in the Simulation operating system and NS2 has been installed in Linux. We use C++ to compile a discrete event simulator. After NS2 is recompiled successfully, we compile TCL scripts to generate simulation scene and control of process, then the simulation data is extracted to analyze. Set media streaming rate is 500Kbps, the data block is 128 KB, section ratio of 1: 5, the node buffer size is 120s, the number of the partner (4, 6), parameter γ value is 1.5, M is 3. We regard the time of the buffer equal length data blocks as evaluating standard, for not losing justice to each of the 10 experiments take the average value is compared.

In order to analyze the performance of the algorithm, LDSA and traditional scheduling algorithm were compared, the main test index is the playback start delay. We define the start delay as a time interval, which is from a user sends a streaming playing request to start playing.

Fig. 1 depicts time curve which two kinds of scheduling algorithms buffer one media steaming. From fig. 1, with the buffer data increasing, their buffer time increase. When the same 60s streaming data is buffered, the traditional method has spent around 20s, and LDSA spent just 10s. In most cases the buffer of equal time playback data, the time of LDSA is less than the traditional method. Thus, LDSA is superior to the traditional scheduling algorithm.

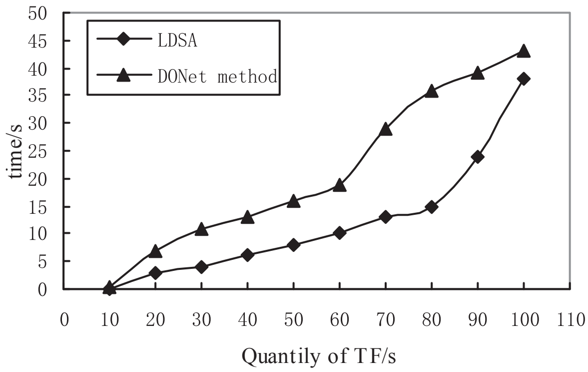

Fig. 1.The chart of the start-up delay comparation

5. The Conclusion

In the analysis of media streaming solutions, at the same time, this paper fully affirms the advantage of P2P media streaming based on Data-driven Overlay Network, according to it' s characteristics, a simple and effective live media streaming scheduling algorithm(LDSA) is proposed on the basis of the existing DONet scheduling algorithm. The algorithm is combined with the least priority strategy (RF strategy), and had considered the priority of the urgent data and the waiting times of the urgent requests. Through compares with the existing scheduling algorithm, the experimental results are proved that LDSA have the prominent performance in reducing the start delay and enhancing the media broadcast quality.

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